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Nutrition and the Human Eye*

Russell M. Wilder, M.D.

THE author presents the effects of diet deficiencies on the eye, and "emphasizes the need for exploration of the rôle of chronic malnutrition in the causation of degenerative diseases."

MY father was distinguished as an ophthalmologist. My own interests for several years have centered in nutrition. The two fields overlap and it may not be inappropriate for this first William Hamlin Wilder Memorial Lecture to relate to the border zone in which both ophthalmology and nutrition are involved.

The subject matter concerning which I wish to speak is contentious in certain of its aspects. Some of those engaged in studies of nutritional deficiency, including several ophthalmologists, have been over-enthusiastic. Others, with self-satisfied skepticism, have closed their eyes to advances of importance. It is my intention first to review certain evidence that must not be neglected, then to engage in some conjecture, in the hope thereby of pointing out the need for more research.

The subject is of great importance now, when much depends on the visual acuity of those who stand guard on our battle fronts or who man our ships and airplanes. We must not fail to apply the knowledge that exists nor to develop new knowledge as rapidly as possible.

It should be recognized that a state of nutritional deficiency exists whenever the supply of an essential nutrient is less than is required to maintain conditions in the organism that are satisfactory with respect either to growth or to the metabolic activities dependent on that nutrient. The results, in sequence, of any such

* First William Hamlin Wilder Memorial Lecture, delivered at the Postgraduate Assembly on Nutrition in Wartime, November 18, 1943, and reprinted from the Proceedings of the Institute of Medicine of Chicago.

deficiency, are: diminished excretion of the substance in the urine, usually accompanied by its lowered concentration in the tissue fluids; depletion of the body's reservoirs; changes in function, as evidenced by abnormality either of growth or of stages in intermediary metabolism which depend on enzymes, themselves dependent on an adequate supply of the nutrient; microscopic changes in the tissues; and finally the abnormalities characteristic of what has heretofore alone been recognized as deficiency disease. These various stages may be passed successively with more or less rapidity, depending on the intensity and duration of the inadequacy in question. The acute, severe process quickly leads to abnormalities that are readily detected. The mild process, whether acute or chronic, may easily escape detection or lead to abnormalities which are not attributed to malnutrition.

Acute, severe deficiency conditions result from diets that are grossly inadequate. They also arise, however, as secondary manifestations in other diseases. For instance, certain symptoms and signs developing in the presence of cancer or of some other anatomic lesion of the gastro-intestinal tract, of a type which interferes with digestion or absorption, frequently can be related to the failure of absorption of one or several nutrients. Likewise deficiencies develop in the course of diseases in which fever is provoked or in the course of hyperthyroidism or some other disease which raises requirements beyond what can be satisfied by the best of diets. The number of these so-called conditioned states of malnutrition is more important than has been recognized. The contribution of malnutrition to the symptomatology of disease in general deserves much more attention than it has received.

Night Blindness

A conditioned deficiency which involved the eye was reported several years ago from the Mayo Clinic.[1] In this case a gastrocolic fistula, developing after an earlier operation on the stomach, permitted direct passage of food from the stomach to a distal segment of the bowel. Digestion and absorption were thereby interfered with. The excreta were filled with undigested fat, and under circumstances such as this the fat soluble vitamins, including the pre-

[1] Wilbur, D. L., and Eusterman, G. B.: J. A. M. A. 102: 364, 1934.

cursor of vitamin A, carotene, are lost with the fat. Night blindness developed in this case, but when the gastrocolic fistula was repaired so that the food again passed through the small intestines digestion and absorption were restored and the night blindness promptly disappeared.

Another type of conditioned deficiency of fat soluble vitamin A is recently arousing much concern. Mineral oil, which is so much used as a laxative and, still more unwisely, is sometimes used in so-called slenderizing salad dressings, dissolves the fat soluble vitamins in the bowel and interferes with their absorption. Since the rationing of fats, this oil, which requires no ration points, has been used in place of fat in frying potato chips and doughnuts, or even has been used in place of shortening in baked goods. However, numerous cases have been cited in the past, like the one reported by Dr. Jeans.[2] The deficient dark adaptation of his little patient could not be cured by large doses of fish liver oil rich in vitamin A. The child was taking mineral oil, and when this practice was stopped the vision promptly became normal.

An example of dietary inadequacy leading to night blindness is provided by a story told to Dr. W. L. Benedict by his ophthalmologist friend, Dr. O'Brien. Sitting in his office the doctor watched three men approaching. The one in the center was guided by the other two. A carefully taken history revealed nothing other than the fact that this man's vision had been failing for the past few months. The examination revealed nothing except a peculiar haze on each cornea; no signs of glaucoma, optic atrophy, or other obvious abnormality. Even use of the slitlamp disclosed nothing more than diffuse epithelial disturbance of the cornea. However, the thought of deficiency of vitamin A led to questioning about night blindness. The man had noticed poor vision on dull days in the house and when he fed the stock at dusk. His diet consisted of potatoes; no butter, eggs, meat, milk, or leafy green and yellow vegetables, just potatoes. The potatoes presumably were white, since sweet potatoes would have provided a source of carotene, the precursor of vitamin A. He agreed to drink a quart of milk a day, to eat large portions of butter, fresh vegetables, eggs, and fatty meat, and to take a daily dose of cod liver oil. Within a month the

[2] Minnesota Med. 16: 688, 1933.

vision was restored. Dr. O'Brien almost missed the diagnosis in this case. Vitamins, as he said, were in the background then and one would not suspect a vitamin deficiency in a prosperous farmer in the corn belt.

Nutritional night blindness has an old, extensive history. The Chinese knew of it in ancient times and treated it with liver, an excellent source of vitamin A.[3] Gross abnormality of this type is certainly not common in our country, and interpretation of the results of the multitude of technics and of the results of use of the many instruments which recently have been introduced for measuring lesser degrees of this condition, is a subject of dispute. Suggestive of the significance to industry of minor disturbances of this type is an observation quoted by Sherman,[4] that workmen receiving more vitamin A were more efficient in matching the whiteness of tiles. The relationship of mild degrees of vitamin A deficiency to the frequency of automobile accidents is probable although not as yet established, and disappointment has been expressed over the lack of benefit from administering this vitamin to the flyers in the Royal Air Force. The suggestion recently has been made that an as yet unidentified nutrient, present in fresh vegetables, is also necessary for good night vision. Soldiers in the Sudan, where the diet contained very little vegetable although liberal amounts of liver, eggs, and milk and thus enough vitamin A, were found to have abnormal dark adapted thresholds.[5]

Night blindness represents a disturbance of function. Visual purple, so-called rhodopsin, is the photoreceptor substance of the rods; visual violet, or iodopsin, is the photoreceptor of the cones. The sensitivity of the retina at any stage of adaptation is determined by the concentration of these receptor substances. They bleach on exposure to light, liberating vitamin A, and simultaneously the threshold for light is raised. In the dark, regeneration of these substances and of visual acuity is normally rapid. Vitamin A is thus regarded as a precursor as well as a product of the visual purple and violet substances, and on deprivation of this vitamin

[3] Lee, T'ao: Chinese M. J. 58: 314, 1940.

[4] The Science of Nutrition, New York, Columbia University Press, 1943.

[5] McCrae, T. F.: Squadron Leader R. A. F. report to Food and Nutrition Board, Oct. 22, 1943.

synthesis of the photoreceptor substances is inhibited,[6] with resulting slow return of vision after bleaching of the retina by light.

Nutritional disturbances of function of the type limited to chemical changes such as the synthesis of the photoreceptor substances of the retina usually respond to treatment rapidly, and, in point of fact, nutritional night blindness usually is corrected rapidly by administering vitamin A. This might lead to the conclusion that it represents a relatively mild deficiency condition and therefore be of fairly common occurrence. However, the body's stores of vitamin A are large, and for this reason experimental subjects who previously have been well supplied with vitamin A can be maintained for many months on diets very low in vitamin A without developing detectable night blindness.

Xerophthalmia

In xerophthalmia the cornea is thickened by hyperkeratosis. Softening follows, later ulceration, with resulting infection of the eyeball and loss of sight. This is the tissue lesion which long has been attributed to deficiency of vitamin A. It now is rarely seen in the United States or Europe, but formerly was not uncommonly encountered among pellagrins in the southern states. In the Orient and in certain parts of Africa it is commonly encountered now. Reports of 15 per cent of 4,000 school children with xerophthalmia in Bengal, of 83 per cent of certain groups of children in Tientsin, China, and of 65 per cent of the blindness of Ceylon being attributed to xerophthalmia are cited by Sebrell in his recent chapter of the "Handbook of Nutrition."[7] The relationship of vitamin A to this disease was established during the period of the first World War. McCollum and Davis,[8] in 1913, from the failure of rats to grow when they were deprived of certain lipoids, suspected the presence of a vitamin contained in fat. A year later Osborne and Mendel[9] noted inflammation in the eyes of animals when they were receiving diets deficient with respect to butter and other fats. Then came Bloch,[10] in Denmark, who studied children with xeroph-

[6] Wald, George: J. Physiol. 19: 351, 1935–1936.

[7] J. A. M. A. 123: 280, 342, 1943.

[8] J. Biol. Chem. 15: 167, 1913.

[9] Id. 17: 401, 1914.

[10] Ugesk. f. laeger: 79: 309, 349, 1917.

thalmia in the last World War. The Germans had been paying fancy prices for Danish butter and in consequence the Danish children were deprived of butter fat. Bloch was impressed with the striking efficiency of cod liver oil in the treatment of these patients, but it remained for McCollum and Simmonds[11] to provide the correct interpretation of the effect of the cod liver oil. "It is not true," they said, "that a fat starvation was responsible for the condition, but rather lack of the unidentified dietary factor, fat soluble A, which occurs in just those foodstuffs which have been observed to possess curative properties." In point of fact, the Danish children had not been seriously deprived of fat. They had substituted margarine for butter. The experience led to a Danish regulation requiring that all margarine be fortified with vitamin A. It accounts for the interest in fortification of margarine in our country at this time of butter shortage.

Thickening of the epithelium of the conjunctiva accompanies the hyperkeratosis of the cornea in xerophthalmia. According to the view held by Kruse, the conjunctival lesion may develop independently, especially if the deficiency of the vitamin is slight and the duration of the deficiency is long. I shall return to this again, after first reviewing other nutritional lesions of the eye which, being more acute, have received more general recognition.

Ariboflavinosis

The effects of deficiency of riboflavin are manifested early in the eye. The work of Bessey and Wolbach,[12] using the slitlamp *in vivo* and injection methods postmortem, demonstrated conclusively that lesions of the cornea developed in rats given a diet inadequate only in riboflavin. Vascularization was the earliest and most constant abnormality to be seen. Later leukocytic infiltration of the epithelium produced superficial and interstitial opacities. Moreover, cataract occurred inconstantly, as previously had been observed by others. The experimental lesions of the cornea were corrected by administering riboflavin, although the changes in the lens were not affected. The first clear evidence that lesions such as this may be found in man was brought by Kruse, Sydenstricker, Sebrell, and

[11] J. Biol. Chem. 32: 181, 1917.
[12] J. Exper. Med. 69: 1, 1939.

Cleckley.[13] Nine men and women receiving a deficient diet had ocular lesions associated with itching, burning, and a sensation of roughness in the lids. In five of these persons corneal opacities were grossly visible. In every case examination with the slitlamp revealed dilatation of the vessels encircling the limbus and invasion of the cornea by capillaries arising from the limbic plexus. The lesion was not benefited by giving thiamine, niacin, ascorbic acid, or vitamin A. It was corrected—"cured" was the word used in the report—by giving riboflavin, and relapse occurred on its withdrawal. The corneal lesions were accompanied by other signs of insufficiency of riboflavin, namely cheilosis, glossitis and seborrheic dermatitis, and these signs likewise progressed or receded in parallel with the discontinuance or administration respectively of riboflavin.

These authors later amplified their earlier report. The patients in eighteen of the added cases were institutional employees who supposedly had adequate diets and were considered to be well nourished. However, all but two complained of visual disturbances such as photophobia, diminution of vision, or eyestrain not relieved by glasses.

An important study bearing on this subject was reported this year by Tisdall, McCreary, and Pearce[14] of the Royal Canadian Air Force. The vitamin riboflavin is rapidly destroyed by light, and it seemed possible to these investigators that the men in their air crews, exposed to glare as they were for long periods of time, might be expected to require more riboflavin than was provided by their rations. Slitlamp examinations were made of the corneas of 198 of these men and some degree of abnormality was found in every case but one. The degree of change was designated as stage 3 in 93, or 46.9 per cent of the men examined. The lesion in this stage 3 was described as proliferation of the vessels of the limbic plexus and penetration of the cornea with twigs, streamers, and loops. Two of every three men with these lesions of stage 3 complained of two or more of the symptoms encountered in deficiency of riboflavin; symptoms such as tiredness of the eyes, aching and watering of the eyes, sandy sensation under lids, dizziness, headache, intolerance for reading, and decreased visual acuity.

[13] Pub. Health Rep. 55: 157, 1940.
[14] Canad. M. A. J. 49: 5, 1943.

A number of the men were given riboflavin, a comparable number received a placebo, and photographs of the eyes of all were made at intervals. Special equipment permitted large magnification and rapid exposure. The subsequent events were notable. Of the men who received placebos, 28.6 per cent were worse and significant improvement was observed in none; of those who received riboflavin, almost all obtained symptomatic improvement, and photographs revealed recession of the vascularity of the cornea. The recession was described as marked in more than two-thirds of all the men examined.

The rapidity of the response to treatment in the cases of these flyers suggests severe deficiency of relatively short duration. The severity of the deficiency is puzzling. Assays of the rations showed the average intake of riboflavin to be 1.6 mg. daily. This amount is well below the 2.7 mg. recommended as a daily allowance by the National Research Council, but a study conducted in the Mayo Clinic laboratories has suggested that the minimal requirement of this vitamin approximates only 0.5 mg. per 1,000 calories. Indeed, no ocular lesion was observed in a period of 290 days when the intake provided only 0.35 mg. per 1,000 calories. The subjects of our studies were not exposed to light nor were they under any physical or ocular strain, and from this it would appear that the flyers of the Royal Canadian Air Force who received approximately 0.5 mg. per 1,000 calories may have been obtaining enough riboflavin to protect them under ordinary circumstances but not enough for the conditions of their flying service. What factor increased their requirements is not as yet established. Recent studies supported by the National Research Council have not thus far supported the hypothesis that light, per se, affects requirements for riboflavin. Eyestrain possibly was the factor of importance. The search for submarines in which the airmen were engaged would involve long hours of visual strain. Other conditions of the environment also may have played a part.

Thiamine Deficiencies

Another state of acute deficiency which affects the eyes has been observed in Wernicke's disease. This usually, but by no means always, is encountered in alcoholic subjects. The syndrome, as

described by Jolliffe and his associates,[15] includes neuritis (peripheral polyneuropathy), varying paralyses of the muscles of the eye, clouding of consciousness, and ataxia. It also may include optic neuritis as in the first case to be described by Wernicke and in a fatal case reported from our clinic by Ecker and Woltman. Palsy of the sixth cranial nerve with resulting internal strabismus is regarded as an early manifestation. In cases of greater severity some of the muscles innervated by the third nerve are involved. The deficiencies represented in Wernicke's disease are usually multiple, but the palsied muscles of the eye respond with dramatic rapidity on giving thiamine.

In his discussion of the case of Wernicke's disease which Ecker and Woltman[16] reported, Wagener related observations at the Mayo Clinic of several cases of pernicious vomiting of pregnancy and of vomiting after abdominal or pelvic surgery. The patients were confused, their vision dimmed, the ocular muscles palsied, and hemorrhages and, in some cases, edema of the optic disks were observed on examination of the retina. The patients were rapidly restored when thiamine was given. The vision usually improved first, the paralysis of the muscles later. Wagener tells me that he sees such cases rarely now, since patients given glucose intravenously for vomiting in pregnancy or after operation are also, routinely, given thiamine.

Severe deficiency of thiamine, as has been demonstrated repeatedly in animals and more recently by my associates[17] in man, provokes bilateral peripheral neuropathies which resemble those observed in beriberi. The predominant effect is in the legs. The arms are palsied later when the involvement of the legs has extended to production of atrophy of muscles. Also found in cases of severe deficiency of thiamine are signs of involvement of the spinal cord, loss of vibratory sense, loss of knee jerks, and development of the Babinski sign. Sensation is affected. Numbness and tingling in the toes are early symptoms, plantar dysesthesia, and tenderness of the calves. Peripheral polyneuropathy, such as that described, has long

[15] Arch. Neurol. & Psychiat. 46: 569, 1941.

[16] Proc. Staff Meet., Mayo Clin., 14: 520, 1939.

[17] Williams, R. D., Mason, H. L., Power, M. H. and Wilder, R. M.: Arch. Int. Med. 71: 38, 1943.

received a recognized position among nutritional diseases. It represents severe deficiency disease, a tissue lesion of the nerves. Less well recognized are the symptoms of more chronic mild athiaminosis. Investigations, among them studies at the Mayo Clinic,[18, 19] have revealed that the primary abnormality in moderate deficiency of thiamine is one of function of the central nervous system. A syndrome develops which resembles neurasthenia. The subjects complain of lassitude and fatigue, of anorexia and dyspnea, of anginoid pain and palpitation. Objective signs are few at first. The amount of pyruvic acid in the blood, when glucose is administered, is abnormally elevated, an indication of disturbance in the metabolism. Occasionally some sugar is excreted in the urine—a pseudodiabetes. Alterations may be observed in the electrocardiogram and the motility of the bowel may be diminished. I regret now that we did not subject our subjects to tests of ocular accommodation. There is a problem here that calls for study. I strongly suspect that fatigue of the muscles of the eye will be found to accompany the other signs and symptoms of chronic, mild athiaminosis.

Chronic Malnutrition

Thus far in this review I have dealt with manifestations of nutritional deficiency which are relatively noncontentious. The incidence of most of these disturbances, like that of frank scurvy and rickets, is small. Their significance, therefore, from the standpoint of the health of the public at large is relatively unimportant. This is true at least for populations like those in most of the states of the United States, where abundant fresh vegetables, fruits, meat, and dairy products are relatively accessible to almost everyone. It is well to bear in mind, however, that almost every survey of what people actually eat has shown that the large majority of the diets of these better-fed populations fail to measure up in one or more particulars to the standards of nutritional requirements developed by the Food and Nutrition Board of the National Research Council. It is also well to bear in mind that while few people in this country are sick, very few are really well, and that the problem of the semi-well has been shown to be enormous by the number of registrants

[18] Williams, R. D., Mason, H. L., Wilder, R. M. and Smith, B. F.: Id. 66:785, 1940.
[19] Williams, R. D., Mason, H. L., Smith, B. F. and Wilder, R. M.: Id. 69: 721, 1942.

rejected by the army. According to the testimony given at hearings of the Committee on Military Affairs of the United States Senate,[20] not much more than half of all employables in the age group 18 to 37 years can be classified as physically fit for full military duty; for the age group 35 to 39 the percentage is but 30.7, less than one man in every three.

Life expectancy in this and other forward-looking countries has almost doubled in the last half century, owing largely to control of sanitation, but extending length of life does not alone imply creating a more healthy life. Indeed, it hasn't done so. We constantly are reminded of the rising incidence of what are called degenerative diseases, and almost every day are shocked to learn of someone, well known to us, who has died abruptly in middle age at the height of his productiveness. I find it impossible to avoid concluding that minor deviation from what has been called a satisfactory intake of one or another of the several essential nutrients plays a part of great importance in the picture of poor health. I therefore regard the next great responsibility of our profession to be extension of the concept of disease prevention to poor health prevention. Moreover, I am confident that this can be accomplished most effectively by an attack directed at nutrition.

In all discussions of nutritional disturbances it is important to distinguish clearly between acute and chronic processes, also to remember that deviation below the optimal intake in the case of any essential nutrient may be marked or only slight. All degrees of variation, both of intensity and duration, must be expected, and the effects of any deficiency will be further modified by capacities for adaptation, depending on individual differences of the persons affected. The importance of these distinctions has been pointed out by Kruse,[21] but thus far, except by very few, little thought or study has been directed to the chronic mild deficiencies. Kruse has emphasized that the lesions induced by mild chronic nutritional deficiency may not at all resemble those of early severe deficiencies, except as acute severe deficiencies may be superimposed on the conditions created by chronic deficiencies. It is not unusual, especially in

[20] Sanders, Lewis: Hearings before the Committee on Military Affairs, U. S. Senate, S. 666, Part 24, June 8 and 9, 1943, Table IX, p. 1167.

[21] Milbank Memorial Fund Quart. 20: 245, 1942.

pellagrins, to find acute lesions in combination with more chronic abnormalities.

Damage to tissues may be provoked by a variety of injuries, from the grossest forms of mechanical insult through poisonings of various kinds, many of them originating in bacteria or viruses, to deviation from the normal composition of the fluids which bathe the cells of the body. The blood and tissue fluids provide the internal environment, the *milieu interne* of Claude Bernard. A certain degree of fixity is characteristic of this *milieu interne*, as Bernard taught, yet changes do occur in it. Alteration of the amounts of hormone carried in the blood has profound and frequently dramatic effects on growth and on metabolism. Alteration in the amounts of the various nutrients which reach the tissues through this milieu has comparable effects.

Sherman's recent book "The Science of Nutrition" is recommended reading for those who hold too strongly to the view that vigor and longevity are predestined from conception. Sherman makes it clear that much of what is commonly called constitution and attributed to chromosomal endowment is owing to the body's internal environment which may be influenced for better or for worse through the food ingested. There is good reason to expect that long-term use of the guidance which the science of nutrition now offers can greatly ameliorate a large part of what passes for irreparable inadequacy, and that the level of health of many unhealthy adult people can be advanced to the status of more fortunate people supposedly born with better constitutions. There is even better reason to expect that the application of this knowledge to the maternal organism during pregnancy and its subsequent continued application to the child can prevent much of the type of disability which so commonly is diagnosed as constitutional inferiority and attributed to poor heredity.

Heredity itself may involve an element of nutrition, namely inheritance of good nutritional instincts. Sherman cited Hopkins as emphasizing this when speaking for both biological and chemical science as president of the Royal Society. Sherman also cited Dove as pointing out "that the 'innately superior' animal in a farm flock or herd thrives better in a given environment than do his fellows, largely because he is born with instincts which lead him to make a

better-than-average use of what the nutritional environment affords." In other words, the animal possessed of what is supposed to be an innate superiority thrives better than others in his herd, largely because he is born with instincts which lead him to select more advantageously than the others from the foods he finds available. His inborn superiority includes a superiority of nutritive instinct. One may see this manifest in children. Billie, more than a year younger than his 3-year-old brother Tom, puts Tom to shame at table by eating what is put before him. He especially likes his milk. In consequence Billie now weighs more than Tom and is more sturdy. However, if the animals possessed of what may be inferior food instincts are fed according to the example provided by the better feeders of the herd they do as well as those with better instincts. Likewise, as has been shown by the British milk-in-school scheme, the addition of milk to children's diets has supported better growth, better fitness, greater alertness of attitude, and buoyancy of spirits. An effect of added thiamine on learning has been demonstrated in a recent well-conducted study in an orphanage in Virginia. In every one of the 18 tasks on the program a vitamin-fed group of children surpassed a group not vitamin-fed in making gains, although the two groups were initially well matched. The content of thiamine in the diets of both groups of these children had previously averaged 0.9 mg., a daily intake which probably is no less than many persons usually obtain, but is less than optimal. The superiority of the vitamin-fed group varied among the measured activities from 7 per cent to 87 per cent, with an average improvement of 27 per cent.[22]

All who have had much to do with treating diabetes have seen diabetic children whose parents have continued to restrict the diet to a prescription received from the doctor when the child was very young. These children fail to grow or their growth is retarded. In such a case if the error is corrected soon enough growth will be resumed. If, however, the interval of time is long before the dietetic error is corrected, the individual remains a dwarf for life. It is not to be supposed that the inferiorities occasioned by long-term insufficiency of the supply of any nutrient essential for the maintenance

[22] Harrell, Ruth F.: Effect of Added Thiamine on Learning, New York, Bureau of Publications, Teachers' College, 1943.

of an optimal internal environment can be corrected overnight, or even after many months of treatment with massive doses of the nutrients which have been lacking. When compared to the effects of severe acute deficiencies, the damage to the tissues which results from an only slightly less than satisfactory composition of the internal environment is slow in developing. It also is slow to cure. It may or may not be reversible. If it is reversible the restoration may be incomplete and leave the tissues more vulnerable to later exposure to a poor diet. A group of active soldiers was given a ration suboptimal with respect to several vitamins during a period of vigorous physical exertion. Some of these men carried visible scars of past episodes of malnutrition. Those who did so, broke down much more rapidly than the men who from their histories had been better fed from childhood and were free from signs of previous nutritional disturbances. This greater vulnerability of tissues previously damaged by episodes of deficiency may well explain the greater vulnerability of the aged to nutritional deprivations. In a current study, two groups of men received a diet constructed to be borderline with respect to thiamine and other vitamins of the B complex. After three months of this regimen one group, composed of individuals more than 60 years of age, showed clear-cut signs of lack of thiamine. The group composed of younger men did not reveal these signs, although in both groups saturation tests showed marked deprivation of the tissue stores of thiamine.

The principal benefactors of the scientific knowledge of nutrition will be the children. The damage done by bad food habits by the time that adult life is reached are probably extensive, with premature so-called senescence as the consequence. However, even in the aged, some degree of reversibility of effects of chronic malnutrition may be obtainable by long-time use of ample doses of certain nutrients. There is much dispute about the significance of the lesion of the conjunctiva which Kruse attributed to chronic deprivation of vitamin A. I referred to this before when discussing xerophthalmia, and stated that this lesion of the conjunctiva might occur independently of the lesions of the cornea of xerophthalmia.

Normally the human sclera is a pale blueish white coat covered with a transparent thin layer of conjunctiva. Deficiency of vitamin A, according to Kruse, results in loss of the transparency of the

conjunctiva, lack of luster, followed by irregular thickening and increase in vascularity. The thickening is most marked in the equators of the eyes on either side of the cornea. In its more advanced stages it is called a Bitot spot, after Bitot who described it in persons suffering with night blindness. As the lesion progresses it involves more and more of the white of the eye and is accompanied by swelling and injection of the caruncle and the plica. Wiehl and Kruse[23] found a high per cent of the pupils in a public high school and many WPA employees having some degree of abnormality of this type. Jolliffe[24] found such conjunctival abnormalities in a very high percentage of all the patients admitted to the wards of the psychiatric division of Bellevue Hospital.

Kruse's interpretation of this conjunctival lesion has been seriously questioned.[25] The abnormality is looked on by many as a so-called natural consequence of aging. The difference in the point of view is less important, to my way of thinking, than the fact that after many months of administration of vitamin A, given as a specific therapy in high doses, these lesions of the conjunctiva may nearly disappear. Also significant, as Kruse has pointed out, is the fact that not all elderly persons show these lesions, and, on the other hand, that they may be found in children.

Another lesion of the eye which Dr. Wagener tells me is commonly attributed to senility by ophthalmologists is colloid degeneration of the choroid. It is commonly encountered in the aged, but is also often seen in younger persons of the type who frequently receive the diagnosis of constitutional inferiority. Massing in the macula of deposits of this type interferes with central vision and is then described as senile central choroiditis. The possible nutritional significance of this lesion has been pointed out by Yudkin.[26]

To attribute tissue lesions to senility seems to me like shirking a professional responsibility. Call a lesion senile if you will, but not a lesion of senility. Senescence is a product of tissue damage, not a cause. When the culture medium is regularly renewed *in vitro* tissue

[23] Milbank Memorial Fund Quart. 19: 241, 1941.

[24] Nutrition and the Deficiency Diseases. In: New York Academy of Medicine. Committee on Public Health Relations: Preventive Medicine in Modern Practice, New York, Paul B. Hoeber, Inc., 1942.

[25] Berliner, M. L.: Am. J. Ophth. 22: 32, 1942.

[26] Arch. Ophth. 23: 60, 1940.

cultures do not become senescent. These cultures in an optimal controlled environment are immortal. Degenerative lesions are encountered more commonly among older men and women because with age more time has been involved, time in which to suffer from the ill effects of uncontrolled environments. Time, however, does not start the changes. It is rather a dimension, as Kruse expresses it, over which effects, resulting from injurious environments, may accumulate and progress.

In connection with the part played by the nutritional environment in provoking changes in human tissues it is pertinent to recall the amazing improvement frequently observed in cases of cirrhosis of the liver in which treatment, as is now a common practice, has been by dietetic measures. These patients receive a diet rich in carbohydrate, liberal amounts of casein, and supplementary doses of vitamins—the B complex, ascorbic acid, and vitamins A and K. Which of the nutrients used is responsible for improvement in these cases is as yet not known, but the fact that this disease responds as it does provokes the suggestion that nutritional deficiencies have contributed importantly to its development. In point of fact, cirrhosis of the liver can be induced experimentally in animals by restricting certain nutrients.

Few persons at all times throughout life have received diets that are adequate in all particulars. Moreover, as I said earlier, states of malnutrition may be conditioned by infections as well as by other diseases which either increase the requirement for nutrients or disturb their absorption from the intestinal tract. They likewise may be conditioned by alcohol, by overwork, even by overeating. Opportunity for recovery from these conditioned episodes of nutritional deficiency is given to few persons for the simple reason that convalescence from disease is rarely scrutinized from the standpoint of nutrition. The longer a person lives the more time he has to accumulate the scars that necessarily must result from each such period of insufficient nourishment.

These inferences are strengthened greatly by the fact that what at long last is beginning to be recognized in man has been common knowledge with respect to animals for many years. Sherman, whose pioneering in this field is of great importance, has summarized the results of experiments in his and other laboratories. By improved

feeding colonies of rats have been developed in which the age span has been lengthened to what would almost represent an additional decade for a man. Furthermore, this added life has not been at the end of life but in the middle—a lengthening of the period of greatest vigor and vitality. This repeatedly has resulted from bettering not poor diets but diets which previously had supported growth and reproduction and were considered good. The opposite of this effect is seen in India where the average span of human life is limited to 27 years. Lack of sanitation plays a most important part in the shortened life span of the Indian, but sanitation is not alone the answer. The malnutrition in large areas of India is proverbial and malnutrition shortens life, both directly and by predisposing to infection. Also bearing on this subject is the difference in sickness and death rates in all countries between income groups. It is not heredity alone that contributes to the greater health and vigor of the so-called upper classes. The ability to purchase better diets plays a most important part. Good evidence of the reliability of this conclusion is the improved health record of the British in this war. Better average feeding, so effectively provided by the Ministry of Food, must account for this, since every other aspect of the health environment has been worsened. Every fifth house in London has been rendered uninhabitable by German bombings. Congestion is terrific. Crowds sleep in subways and other shelters against bombing, and every other doctor has been drafted for the army.

Plans for conservation of our natural resources must include provision for the adequate nutrition of the population. There is no greater waste in the world than that involved in raising a child through the many years of human youth and adolescence to have him die, as he does on the average in India, in the early years of his productiveness. It is almost equally wasteful to have him live, as so many of our people now live, in feeble health and unproductiveness. Improving diets can reduce this waste of human raw material. So obvious is the deduction from the mass of evidence now available as to make incomprehensible the attitude of the few who either pretend there is no problem of malnutrition, in what they call our well-fed population, or oppose the practical application of the knowledge that is now available. There is a tendency

among physicians to discount much of what has been learned by surveys of food consumption in samples of the population. This I think can be explained by their unfamiliarity with statistical procedure. There also is a tendency to discount much of what the laboratory rat has taught us, whereas in point of fact the rat in eating habits and digestive mechanisms is closer kin to man than is the dog. The misunderstanding of some of those exhibiting this attitude is abysmal. The following comment is an example. It is quoted from a book review recently printed in a medical journal: "Every physician who has ever seen women with *anorexia nervosa*, starved for years until they were down to 80 pounds in weight or less, must have wondered why they didn't develop the deficiency diseases which by all the rules of the game—for rats—they should have developed." In point of fact starvation is a way to cure deficiency diseases, both in rats and men, albeit such a cure may be worse than the disease. Deficiency of calories leaves nutritional lesions of its own making, although preventing or retarding the development of the lesions that result from lack of vitamins.

Conclusion

The bearing of these observations on the eye may seem remote, but obviously the eye, like other organs, is subject to the degenerative changes that accompany or provoke senescence, and if degenerative change can be retarded for the body as a whole, the eye assuredly will benefit. It, therefore, is not unreasonable to suppose that application to human diets of existing knowledge of nutrition, beginning soon in childhood and continuing through life, may delay the development of presbyopia or even prevent the development of lesions such as cataract. It may even be supposed that astigmatism, longsightedness, and shortsightedness will be found to be preventable by suitable attention to the nutrition of the maternal organism during the development of the eye of the embryo. These abnormalities result from minor imperfections of the size and contour of the cornea or of the eyeball, and it has long been known in animal husbandry that depriving cows of carotene gives rise to maldevelopment of the eyeballs of their calves. An incidence of cataract in rats maintained on diets lacking riboflavin has been demonstrated, as I have said. The investigators failed to cure the cataract by restoring

riboflavin, although the corneal opacities and other lesions resulting from restriction of riboflavin disappeared when riboflavin was again supplied. Prevention in the case of cataract may be all that is to be expected from improved nutrition. Other chronic lesions, like cirrhosis of the liver, will assuredly respond as has been shown.

It has been my purpose in the latter part of this discussion to emphasize the need for exploration of the rôle of chronic malnutrition in the causation of degenerative disease. The eye is an organ which lends itself to such investigation. It can be examined not only externally but internally, during life, like the stomach of Beaumont's famous Alexis St. Martin. Abnormalities develop in the eye in the course of most diseases of the type associated with so-called degeneration. The severe acute disturbances of nutrition are reflected by specific lesions in the eye, as has been seen, and it is not unreasonable to expect that further study will reveal reflections there of various types of chronic malnutrition. In this research the ophthalmologist should be able to contribute most importantly. The beams from his ophthalmoscope and slitlamp ought to light the path of human progress from poor to better health.

Future Goals for the Prevention of Blindness*

Eleanor Hearon

EMPHASIZES the need of co-ordinating and integrating prevention of blindness activities in each community; the training of eye workers; and the consideration of the problems of prevention of blindness on not only a national, but an international basis.

ANY goal for prevention of blindness must take into account the medical, social, and community aspects. In other words, this goal can be achieved through the medical field, community organization, and through case work to patients, implementing both the medical and the community attack.

Let us, in general, say that we must first hold to the gains that have been achieved in all of these areas. We must not limit our post-war planning to our own community, town, county, state, or even to the United States. Because of the increasing interdependence of and need for world planning, we shall have to extend horizons and consider prevention of blindness on an international scale. The gains that we have made in the medical field, in community organization, and in better care of the individual patient must be carried over to other communities who still have not as adequate facilities as we.

To reach one of the first goals we should consider the re-evaluation of the causes of blindness. Due to the increase of knowledge of the eyes and the advancement in the medical sciences there has been a shifting of causes of blindness.

Dr. Ralph Danielson in Denver estimates that the 70 per cent of the causes of blindness, which in the past could be laid to ophthalmia neonatorum, trachoma and syphilis, has so changed that

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at the present time these diseases will probably account for approximately only 5 per cent. The infectious disease and accidents which first accounted for much of the cause of blindness in persons up to 40 years of age has had a change because of better and more adequate health facilities and safety measures in industry. One of the physicians in Denver told me that in the early war days of accelerated industry, when manpower and production were the chief problems, the safety of the employee was not taken into account. During the building of Army posts in our vicinity they had often as many as 10 to 20 men in the office daily to have foreign bodies removed from their eyes. After the terrific rush of building was over and the industries were able to get on a more even keel and follow some of the better safety practices, these same doctors have not had more than one patient for the removal of a foreign body, for the past six months. Goggles are being required and the men are given more precautions as well as safety instructions.

The shortage of medical personnel throughout the country has given communities an opportunity to look into the adequacies of medical facilities and opportunities for medical care. The next few years will probably bring many changes in medical practice, and services will be developed which will increase the coverage, provide facilities, and extend the availability of medical services to the people throughout the whole United States. These measures will be in the area of public health social insurance, and also medical services. There will be an increase in preventive medicine, and one of the goals of prevention of blindness is to back and give support to this new field of medicine.

In addition there should be serious consideration to including in health examinations more extensive eye examinations and the use of ophthalmologists. It has been suggested that provocative tests for glaucoma and other potential dangerous eye diseases should be used in the physical examination processes and should be developed further through scientific research. Here again one of the goals should be the awareness of trends and the understanding of the need for extended medical services and the use of these resources in programs for prevention of blindness. To go on with consideration of some of the things which we might think about in reevaluation in causes of blindness, let us turn from the infectious

types to the degenerative. Ophthalmology must tie in with a study of the eye phase of geriatrics. It has been said by those interested in this important field of medical care that to extend the period of life without making the increased years worth living and without offering a healthful active and happy existence to the old, is not meeting the problem.

Let us then think of what this will mean in terms of prevention of blindness emphases and activities. Cataracts, glaucoma, degenerative lesions, macular and fundus lesions of a degenerative nature must be given attention. New opportunities for prevention of blindness in the medical field will point toward research into the causes of degenerative diseases, methods further to determine focus of infection, and the location of that infection. In simple glaucoma, a degenerative disease, efforts should be made to find this in its incipient stages when it is far easier to treat either by myotics or surgery.

As was previously suggested, could not provocative tests be a part of the health examination of everyone over 40 years of age? In the degenerative types of causes of blindness, the ophthalmologist and the general man must co-operate. Good and adequate health examinations which are thorough enough to pick up nephritis, diabetes, and vascular changes, will serve definitely to prevent blindness.

Can we turn from the future to the present, for a moment? We have had an interesting project at the Colorado General Hospital, here in Denver, on preventive medicine. A preventive medicine clinic is set up as a part of the general clinics, and financed partially through the Junior League of Denver. This service is offered to medical students, nursing students, hospital employees, household workers, and it was also extended to two groups admitted on a group basis—the personnel of a local pipe and steel company and the employees of the Denver Orphan's Home. Other agencies have been urged to use this clinic for their clients who have no physical symptoms and who they think need a physical appraisal. The examination included a Wassermann test, urinalysis, full blood count, sedimentation rate, chest plate, and a most thorough physical examination. As far as the eye examination goes, we have been able to do tests for distant, near, and color perception, and the

internist has checked the eyes with an ophthalmoscope. We should like to have ophthalmologists available for a thorough eye examination and to do provocative tests for glaucoma, but this has not been achieved because of the pressure of work and the lack of medical personnel. However, we are aware of the need and when we are able to get a full ophthalmological staff again, we shall be ready to incorporate this again into our clinic. The present, then, often restricts our ability to carry out the ideal, but if we are aware of what can be done in the future and plan ahead, we can be ready to incorporate into our existing procedures new services which will give added service and will develop because we have been aware of the need for re-evaluation of the causes of blindness. This is just an example of holding on to the gains we have, and looking forward to future plans.

Ophthalmia neonatorum is an example of a disease in which treatment has become more efficacious and which might result eventually in a change even in prophylaxis. One of the physicians at home said that he was having to remove the eye of a small child who had 10 per cent silver nitrate at birth. In this doctor's practice he has had five cases in which children have lost their vision because of a mistake. The wax ampules have somewhat controlled the situation, but it is known that at times 10 per cent silver nitrate solution, which may be used for the mother's nipples, has been mistakenly used in the baby's eyes, instead of the one per cent solution. Again the stage of understanding and development in any area will point out new methods or trends in prevention; however, the value of mandatory use of silver nitrate has, in the recent past, and now, shown results by bringing about a decrease of blindness in babies.

Cataract comes under one of the degenerative conditions, which is thought to be on a vascular or nutritional basis. Again the method of prevention is to try and procure for each community more adequate facilities for general medical practice.

As a social worker, I probably should not be making this next statement but it really does bring out one of the goals. A physician recently told me that one method of aiding prevention of blindness of cataract is to have a certification system worked out which would prevent any man from doing cataract surgery who does not have the opportunity to do at least one cataract operation a

month or, as he said, once a week. The ophthalmologists themselves have taken the leadership in setting up standards for eye care and the gains which have been made must not be lost in any new program that is set up. Perhaps they too will go ahead recommending certification for cataract surgery, retinal detachments and some of the more intricate surgical operations. For example, early surgery by competent people is the answer in cases of retinal detachment.

We have all learned something through restricted speed limits and the physicians have seen a decrease in eye injury caused by automobile accidents, within the past two years. Perhaps we can learn something from this which could be continued in the future—not to save tires but to save eyes as well as life and limb.

We have covered a few of the problems which might be considered in a re-evaluation of the causes of blindness. Let us not forget that any prevention of blindness is a three-way problem and deals with ophthalmology and medicine, the patient and his reactions, and community organization. If we see the trend in the increasing life span, this should mean something to us in the care of the patient and in the field of community organization. Persons not only in ophthalmology will have to contribute their share to the field of geriatrics, but the doctor and the social worker will have to learn the problems of the older person, his personality pattern, and ways of dealing with him. This will be a challenge to us and will necessitate real study and learning if we are going to become equipped to deal with the problems of the person from 50–75, particularly those in the 60-75 age groups.

Again, from the community organization standpoint this has implications for development of medical services for this group as well as the development of preventive health examinations for the younger person, if we are to catch some of the difficulties which might be corrected early. We can no longer be casual about the care of the chronics but we must seriously concern ourselves with their problems. In how many areas is there a good preventive health program for the able-bodied, let alone for the chronic and the aged?

We have found in the past that prevention of blindness programs and activities do not just grow or happen, even though there are good public health facilities, industrial protections, and general

safety measures. We must, therefore, continue to believe in and to help develop some official central prevention of blindness agency or division to administer a prevention of blindness program that will co-ordinate the services, point out the lacks and gaps, and consciously integrate and direct prevention of blindness activities. Such a program means that there must be a general understanding of possible prevention of blindness measures; of what constitutes medical facilities and standards; of eye conditions; of the patient as a person; of case work skills; as well as a knowledge of sound community organization and a consideration of personnel and education.

Adequate personnel means that we must continue the gains we have made and the belief that persons who have superimposed upon their general professional equipment special training in the eye—whether it be in medicine, education or social service—do the job better. We should set as one goal the continuation of such courses as the National Society for the Prevention of Blindness has carried on in Washington University, St. Louis and in some of the teachers colleges, for sight-saving teachers. During this period we must prepare for the workers who are needed now and will be needed in the future.

As was said earlier, our job is not just one restricted to the United States. We must again begin to think of prevention on an international scale. We should, therefore, make these facilities available to people of other nations so that they may take back to their countries a knowledge of some of the gains we have made. If one looks at general health education training programs, one sees about the same percentage of attention paid to eyes as is often found in the training of nurses and doctors as under-graduates. We must see that schools which are now preparing people for health education incorporate more eye knowledge and prevention of blindness in their curricula.

The last point which I should like to bring up is one of interpretation. If we have health education, if we have more adequately trained personnel and a central governmental agency to concentrate on prevention of blindness—do we not yet have a problem of further interpreting the skills of the specially trained to medical and public health agencies and medical staffs? How are we to do this?

Perhaps we should take advantage of one of the tragedies of this war—the young men blinded in battle, and the civilians who lost their sight in bombings. Their plight alone should give an impetus to the prevention of blindness activities, especially as the general population will begin to realize some of the personal, social and economic problems of a person who has no vision. This may stir interest in activities which can be directed toward the removal of the causes of preventable blindness. I am told that after the last war, prevention activities received such an impetus.

Medical administrators are often interested in costs and in savings. Good case work services to patients in an eye service tied in with better community planning will be a saving to the patient, to the hospital, and to the community.

In these days of shortages we realize that prompt and effective treatment which is carried out as long as necessary will save time and effort of clinic physicians and the over-worked staffs. We shall have from the rehabilitation services estimates of costs of training of the blind, and this again will give us data which will help us interpret the needs for prevention. Hospitals and hospital administrators are becoming increasingly community minded and are beginning to see their interests as a part of the community picture. By case illustrations and by continual interpretation we can help integrate the needs for medical social service in eye clinics and in eye programs. However, there is nothing which is more efficacious than a job well done and a demonstration to the medical staff of the values to the patients and to the eye service of casework service. One goal, therefore, should be the continuation, on a demonstration basis, of specialized projects in eye services both in public health and in medical care services.

As you can see we have not presented revolutionary ideas, for much of the world's gains are made by setting goals and plodding toward them.

To review, then, the goals we can set before us in the future, we first must re-evaluate the causes of blindness, take heed of these, see the implications in terms of the patient, medical emphasis and treatment, and community organization.

We must continue to work toward the establishment of some means of co-ordinating and integrating the prevention of blindness

activities in each community; we must look into our community planning and organization and see that we utilize existing resources, point out the needs for others and help develop needed resources.

We must continue the training of eye workers and see that in their training we incorporate some of the problems of geriatrics, both medical and psychological.

Let us also remember that as in public health we can no longer be locally minded. Let us widen our horizons to think of the needs and of the problems of prevention on an international basis.

Improving the Visibility of Industrial Tasks

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THE author discusses the rôle of lighting in industrial efficiency.

EACH of the professions represented in the Seminar on the Industrial Aspects of Ophthalmology has its own particular jargon. The illuminating engineering profession is not an exception. The idea of using terminology which has very definite meaning offers a more exact mode of translating a thought from one member of a profession to others of the same profession who are familiar with the meaning and connotations of the words used. On the other hand, when a number of professions make common cause in order to achieve a result far greater than could be obtained by any one of them alone, the different professional languages may hinder progress unless great pains are taken to define and explain as the subjects are developed.

Each profession probably believes that it makes the major contribution to the cause of better industrial seeing. Again the illuminating engineer is not an exception because without light there is no seeing by any one, while there appear to be many who maintain a degree of vision satisfactory for their purposes throughout life without assistance. However, since light and sight are to vision what air and sustenance are to life, the question of which is the more important is rather academic. It is enough to say that brightness, brightness contrast, and brightness ratios are tremendously important factors in the complex process of seeing. Since it is evident that the vernacular will out, a start had best be made with a number of appropriate definitions.

Lumens

The light output of practically all lamps (light sources) which are used for lighting work-world seeing tasks is expressed in terms of lumens.[1] The technical definition of a lumen is not particularly complex; however, it is sufficient only to know that the light output of a 100-watt Mazda C (tungsten-filament) lamp, for instance, is 1,600 lumens—or 1,600 units of luminous flux. The light output of a 40-watt daylight Mazda F (fluorescent) lamp is 1,800 lumens. A 500-watt Mazda C lamp has a luminous flux output of 10,000 lumens while the luminous flux emitted by a 3,000-watt mercury lamp is 120,000 lumens.

Illuminating engineering is quite a simple profession fundamentally. The job is merely to utilize the lumens from the lamp on work surfaces and surroundings to maximum advantage.

Footcandles

Probably the footcandle[1] is the unit about which the most has been heard—though often this unit is referred to as foot candle power, feet candle, feets candles, etc. The footcandle is a measure of the density of the luminous flux incident upon a surface. Thus a lamp emits lumens; if the lumens from the lamp are controlled so that there is a density on the working surface of 100 lumens per square foot, an illumination of 100 footcandles results. That is, a luminous flux density of one lumen per square foot produces one footcandle.

Footcandles are measured quite simply with light meters. It has always been a relatively simple matter to measure footcandles and hence unfortunately this unit has been used almost exclusively in illumination design work. This is unfortunate because our ability to see an object is controlled by the light coming *from* it and its surroundings. That is, our ability to see this page is governed by the light it reflects or by its brightness.

Brightness

Brightness[1] is the expression of luminous intensity. In order for an object to be seen, it must be luminous—whether it reflects the light or emits it. For instance, the luminous intensity, or brightness

of a wall, may be low, while the luminous intensity or brightness of a bare lamp is relatively high.

Footlamberts

The footlambert[1] is the modern unit of brightness. If a surface emits or reflects light at the rate of 100 lumens per square foot, the brightness of the surface is 100 footlamberts. That is, the brightness of a body emitting or reflecting light diffusely at the rate of one lumen per square foot is one footlambert. The brightness of the 100-watt Mazda C lamp is over 50,000 footlamberts. The brightness of the 40-watt daylight Mazda F lamp is approximately 1,500 footlamberts.

Brightnesses are measured by means of suitable instruments. One of the better instruments costs fifteen to twenty times what one commonly used light meter does and requires considerable "know how" to be used intelligently. These are reasons why measuring footcandles is a more popular pastime than measuring footlamberts. However, the future of lighting lies in a full acquaintanceship with footlamberts, and more and more use will be made of brightness meters; therefore, there will be developments leading to lower instrument costs.

Footcandles (lumens falling on a surface) and footlamberts (lumens reflected by the surface) are related by taking the reflection factor of the surface into account. For instance, the quantity of luminous flux incident on this page is practically uniform and yet the brightnesses of the paper and the printing are quite different, because of different reflection factors.

Visibility

When an object is capable of being seen it is visible. When it is capable of being seen well, it is said to have a high visibility. In general the purpose of bringing the lumens from the lamp to produce footcandles on the work (which in turn result in a brightness of the work) is to achieve good visibility. The visibility of an object can be measured by means of an instrument which is called simply a Visibility Meter.

Eye Comfort

It is quite possible to have a high visibility and still not have eye comfort. As a matter of fact, some objects retain a relatively high visibility even when a glare source such as a bare lamp is well within the line of vision—producing a most uncomfortable seeing condition.

Revealing Brightness Contrast and Disturbing Brightness Ratios

Since the solution of industrial seeing problems will be largely by means of brightness engineering,[2] it is necessary to understand fully the sometimes confusing relationships of various brightnesses in the visual field. The matter may be confusing because in one case a high brightness difference will reveal an object while in the other case it will be disturbing to the observer and may conceal the object.

The brightness difference between critical detail and its immediate background which reveals the object is called *brightness contrast.*[1, 2] Since the black letters on this page are much more visible than white letters would be, it is obvious that it is desirable to have a high brightness contrast for easy seeing. Since a high brightness contrast contributes materially to the visibility of an object, for clarity this type of brightness difference can be referred to as *revealing brightness contrast.*

Revealing brightness contrast can be expressed simply as a ratio of the brightness of the critical detail to the brightness of its background. A better interpretation of the influence of contrast on visibility is given, however, when revealing brightness contrast is expressed as "per cent contrast." This is the ratio of the brightness difference between an object and its background to the brightness of the background. Perfectly black print on a perfectly white paper would represent 100 per cent contrast.* Perfectly white print on perfectly white paper or perfectly black print on perfectly black paper would represent 0 per cent contrast.

The brightness difference between the visual task† and its sur-

* $\frac{100 - 0}{100} \times 100 = 100$ per cent

† Composed of the critical detail and its immediate background.

roundings which conceals an object, or is disturbing, is called *brightness ratio.*[1, 2] Brightness ratio is simply the ratio of the brightnesses of any two surfaces. Generally, brightness ratio refers to the ratio of the average brightness of the visual task to that of some surface in the surroundings. For instance, with overly bright luminaires in the field of view there are high brightness ratios between the brightness of the work and the brightness of other surfaces in the surroundings. Low brightness ratios are conducive to high visibility and eye comfort. High brightness ratios in the field of view may reduce visibility and will almost certainly reduce eye comfort. For greater clarity brightness differences of this type can, therefore, be referred to as *disturbing brightness ratios.*

Four Factors Influencing the Visibility of an Object

There are a number of factors influencing the visibility of an object. Possibly the most obvious one is the size of the object expressed in terms of the visual angle which it subtends. While a 48-inch lamp may be relatively large in size for a viewing distance of 30 feet, when the lamp is five hundred yards away from the observer, its "size" becomes relatively small. Within certain limits increasing the size of an object increases its visibility.

Time is a considerable factor in seeing. If a wheel is held still, it can be seen quite easily. If it is rotated slowly, fairly accurate visual impressions can still be registered. However, if it is rotated rapidly, it is found that the visual snapshots are not made with sufficient rapidity to "stop" the action.

The brightness of the work is also a factor. Hence it is not uncommon for a person subconsciously to move toward the window when trying to see a difficult visual task. Since within the average office there may be only five to ten footcandles of artificial lighting with possibly over 100 footcandles at the window, a material increase in brightness is achieved by such a move.

The revealing brightness contrast of critical detail and its background is another factor which influences visibility, as has already been pointed out. Visibility is highest for a given set of conditions when the per cent contrast is at a maximum.

Considerable research has been devoted to determining the interrelationships of the four factors which have been mentioned. Since

in industry it is usually found that the size of the visual task is predetermined, that the time allotted for seeing should be a minimum and that the per cent contrast of the critical detail and its background is fixed, it is apparent that the influence most easily and most universally applicable to increasing the visibility of the task is brightness. Investigations by Luckiesh and Moss show that increasing brightness from .8 to 80 footlamberts increases visual acuity 70 per cent, contrast sensitivity 350 per cent and speed of seeing 230 per cent. These results are well corroborated by researches of Ferree and Rand,[4] Nutting[5] and Lythgoe and Tansley.[6]

Lythgoe[7] has carried studies of the influence of brightness on visual acuity as far as 1,000 footlamberts. His data show that acuteness of vision becomes progressively better up to this level. The data were taken with the brightness of the test patch and the brightness of the surroundings approximately equal, *i.e.*, disturbing brightness ratio at unity. This finding has been corroborated by Moon.[8]

Disturbing Brightness Ratios vs. Visibility

Another considerable influence on the visibility of an object is the ratio between the brightness of the work and the brightness of the surroundings. Continuing with Lythgoe,[7] it is found that when the surroundings are of a different brightness than the test patch, there are definite reductions in visual acuity. Lythgoe and Tansley[6] also show that high brightness ratios reduce the sensitivity to flicker—which is interpreted as meaning a reduction in the speed of seeing.

From the foregoing it is obvious that the matter of brightness engineering is much more important to high visibility than mere footcandle engineering. High footcandles with high or disturbing brightness ratios in the field of view is not a good solution to industrial seeing problems.

Factors Influencing Eye Comfort

In general, the factors influencing visibility also influence eye comfort. It appears, however, that some evaluation of eye comfort is a more valuable criterion of the severity of a visual task than is a measurement of visibility or visual acuity, because discomfort may be experienced before visibility is influenced. This is probably

because comfort includes the element of time—that is, the duration of the period to which the eye is exposed to the visual task.

For the most part, considerations of comfort have been in connection with disturbing brightness ratios in the field of view. One very common example of unfavorable brightness ratio is the all-too-common combination of white papers on dark desk tops. For instance, an office building was relighted from about 10 footcandles to 50 footcandles using well shielded fluorescent luminaires. Not long after the relighting was completed, one of the occupants complained that he had "too much light," or the light from the lamps was hurting his eyes, or something. Since some individuals work close to a window where there may be 300 footcandles (even without the sun shining in), we know that 50 footcandles is not "too much light" and we also know that the light from fluorescent lamps is not harmful to the eyes.[9] However, when an illuminating engineer placed himself at the desk of the individual, it was found that the disturbing brightness ratio between the white paper used and the black desk top was quite trying. Substituting a light linoleum for the black linoleum entirely eliminated all objections from this individual. Not long after, there was a similar case in the building and the same solution was equally effective.

These examples serve to illustrate another point which should be kept in mind, and that is, as brightnesses increase, the disturbing effects of unfavorable brightness ratios become more pronounced.[10]

High disturbing brightness ratios in the field of view require that the eyes go through the process of adapting[11] for the different brightnesses as the eyes follow a natural course throughout the field of view. The effort involved undoubtedly leads to fatigue and in no-wise contributes to the better performance of the visual task. If the eyes are normal, they can stand abuse surprisingly well. On the other hand, if the eyes are sub-normal and the seeing task is unnecessarily severe, the added eye fatigue may reasonably cumulate into a more serious condition. This may lead to general fatigue which could be the source of many industrial accidents.

Lighting and Production

For the majority of industrial tasks upper limits on production are established by the physical ability of the operator to co-ordinate

his movements with those of the process. Making the visual task easier by improving brightness, revealing brightness contrast and disturbing brightness ratios, however, results in a continued contribution to human reserves so that a greater factor of safety is present.

Even at best, attempts to ease visual tasks in industry cannot be 100 per cent successful because it is practically impossible to duplicate the conditions under which the eyes developed. Thus, most industrial tasks will probably be located closer to the near point instead of to the far point—or at distance; continued concentration will be required; the eyes will be used for much longer periods; and it will be quite some time before every one has artificial lighting equal to daylight. The purpose of this lecture is to assure that something can be done about this latter point, *i.e.*, the condition of insufficient indoor light can be taken and improved far beyond anything which has been done to date.

An indication that improving this condition not only has humanitarian aspects but influences production as well, has been found numerous times.[12, 13] It has been the general experience that lighting helps those who need help most. In other words, when there is an increase in the speed of working as a result of increased footcandles, the increase in speed of working of a slower group can be expected to be at a definitely higher rate than the increase in the speed of working of a faster group.

During the past decade, industrial lighting has benefited by a great deal of study and the introduction of types of light sources and lighting equipment which have made superior visibilities available for many industrial tasks. Probably the greatest advance in industrial lighting practice was made when fluorescent lamps were introduced. The use of these lamps has provided factories with large-area, relatively low-brightness sources for overhead general lighting which had been proven by previous studies to be highly desirable for use in industrial work. As a matter of fact, a quality of lighting was made available to the plants which was reasonably comparable to that which might be installed in an office area.

While the Mazda F lamp has revolutionized the concept of overhead lighting for industrial areas, it is quite possible that the major contribution which this illuminant will make to seeing in the in-

dustrial plant will be for close-up lighting. It has been stated that if the factory had been limited to a choice of fluorescent lighting either for overhead general lighting or for close-up (localized) lighting, the wisest selection would have been to use the F lamps for close-up lighting. This is because almost all close-up lighting utilizing Mazda C (tungsten filament) lamps results in a small reflector which becomes quite warm, specular reflections of high brightness, the possibility of high undesirable brightness ratios in the direct glare zone, a small area high-lighted, sharp shadows, etc. The equipment utilizing F lamps is much lower in brightness in the direct and reflected glare zones, provides a larger and more uniformly illuminated area (though possibly at a lower peak value) and results in shadows which are much softer.

It is not to be assumed, however, that the F lamps are a cure-all which can be used indiscriminately. The brightnesses of the lamps are sufficiently high to produce severe disturbing brightness ratios between the work and the light source when the light source is in the field of view of the workers. Investigation of the conditions leading to complaints about "too much light" or the light from the F lamps hurting the eyes will often uncover the fact that the worker is merely suffering from direct glare. Unless there are other unfavorable seeing conditions present, shielding the light source so that the worker cannot see the lamp will take care of the complaint.

Obviously it cannot be expected that all concerned with industrial seeing will become Illuminating Engineers; however, there are many common examples of poor lighting practice which all should learn to recognize. Fundamentally, deficiencies in lighting or seeing conditions in the factory will be due (1) to insufficient brightness of the work, (2) to low revealing brightness contrast between the critical detail being observed and its background, and (3) to high ratios between the brightness of the work and the brightness in the surroundings. The best way to uncover the sources of difficulty is to take a complaining individual's position and attempt to go through the same operations which he does—including eye movements. While doing this, the observer should be on the lookout for:

1. Insufficient brightness:
    a. Due to inadequate overhead illumination.
    b. Due to individual working in his shadow.
    c. Due to lack of needed close-up lighting.

2. Low revealing brightness-contrast between critical detail and its background:
    a. Where the critical detail of an object is seen in silhouette against another surface, the reflection factor of which can be varied to achieve an improved contrast with the object.
    b. Where the critical detail is integral with the object, so that its background cannot be treated separately. (In this case, a more revealing brightness contrast can often be achieved by the illuminating engineer through the use of directional lighting, large-area low brightness lighting or other devices with which he is familiar.)
3. High, disturbing brightness ratios between the work and its surroundings—usually resulting in a condition which is called "glaring" or which causes the individual to complain of "too much light," or the light hurting his eyes:
    a. Artificial light sources in the immediate field of view when looking at the work.
    b. Artificial light sources in the field of view as the eye follows a natural movement pattern while working.
    c. Bright windows in the field of view.
    d. Work brightly lighted, balance of room dark.
    e. Work in shadow or darker than surroundings.
    f. High ratios between brightness of work and brightness of other surfaces in surrounding.
    g. Reference material light and machines dark or vice versa.

There are more complex deficiencies, but the solution to most problems will be found among those enumerated above.

Summary

As the author visualizes the approach toward easing seeing conditions in the work world, it is three-fold.

1. To simplify the requirements for eye co-ordination, *i.e.*, to put the task where it can be seen easily.
2. To make the visibility of the task as high as possible, *i.e.*, by achieving proper brightnesses and revealing brightness contrasts and low brightness ratios; and

3. To fit the eyes to the task, *i.e.*, by selection and correction of eyes.

At the present time the three sources which can contribute are not too fully aware of the complexities and potentialities of their individual fields, much less aware of those of the others who have a mutual interest in the problem. It is enough at this time if each is aware of the contributions which the others can make so that when "a case" arises, we will be sure to avail ourselves of the specialized knowledge of the other groups in order that the work-world may be a better place in which to see.

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Rehabilitation in Relation to Sight Conservation

Dean A. Clark, M.D.

THE author discusses the relationship between the program for the utilization and conservation of eyesight in industry and the forthcoming rehabilitation program for war veterans.

AS is generally known, the Office of Vocational Rehabilitation is undertaking a program designed to implement the provisions of the Barden-LaFollette Vocational Rehabilitation Act Amendments that were passed July 6, 1943.

Rehabilitation is the last step in the chain of events of which prevention is first. It might be thought, therefore, that rehabilitation and prevention are rather far apart, but actually I think they are in spirit very close together. The one thing that the rehabilitation agency would like best of all would be to have nobody needing rehabilitation. When that happy day comes, we shall all be working for prevention.

Unfortunately, that day has not yet arrived, and we have a great many—the numbers are not too well known, but certainly in the millions—handicapped people in the United States, besides veterans, who are either unemployed, or very disadvantageously employed because of their handicaps. The Barden-LaFollette amendments to the Vocational Rehabilitation Act represent an attempt on the part of the Congress to do something about the rehabilitation of these individuals.

The Office of Vocational Rehabilitation is merely the federal agency which supervises the grants-in-aid to the states for this program, which is a federal-state program. It is actually operated by state rehabilitation agencies, which are under the State Boards for Vocational Education, and the State Agencies for the Blind.

The Vocational Rehabilitation Act has been in existence since 1920. It had a number of limitations such as, for example, the fact that there were no provisions for the use of federal funds for the rehabilitation of the mentally handicapped, no provisions for special services to the blind, and no provisions for the use of federal funds for physical restoration.

All those matters have been changed by the Barden-LaFollette amendments, as have the financial provisions. In general, under the amended law the federal aid is considerably increased. There is no longer a ceiling on the federal authorization, and the Federal Government now reimburses states 100 per cent for their necessary administration costs, as well as 50 per cent on case service costs. The total grant-in-aid from the Federal Government therefore amounts to about 60 per cent, or possibly two-thirds of all the money that will be spent on the rehabilitation of handicapped civilians.

There are special services for the blind, and federal funds are available for physical restoration, in addition to the services under the original law, which were vocational training, vocational guidance, placement in employment, and the provision of prosthetic appliances.

We have, therefore, two sets of problems, from the medical side. One is the problem of medical examination and treatment for those persons who require treatment for their handicaps, and the other, the suitable placement of handicapped persons in jobs. The jobs must be such that the disabled persons can do creditably in spite of their disabilities; and second, they must be jobs that will not make the disabilities worse or cause new disabilities.

Since these services are operated by the states, the Federal Office is limited in its functions to the establishment of certain standards and certain guiding principles which the states follow in drawing up their plans for vocational rehabilitation.

The first and perhaps most important single regulation that the Federal Office has established with respect to the medical aspects of rehabilitation, is the requirement that every client must have a general medical examination as a part of the determination of his eligibility for service under the program. That means not only to establish eligibility for medical service but eligibility for voca-

tional training or vocational guidance, or for placement services. Therefore, any person in the United States or its possessions who has a disability, mental or physical, that is an employment handicap, may apply for service to the state agency, and in the process of determining eligibility, that individual receives a general medical examination.

How far the states will go in examining the eyes of these applicants is hard to say. Frankly, up to now, I am afraid it hasn't always been as far as one might like. In the *Manual of Policies for Physical Restoration*, we have made the statement that the services of a qualified ophthalmologist must be secured for the examination of any individual who has a visual handicap that requires, in the opinion of the examining physician, something other than refraction. We recommend that all visual handicaps be examined by ophthalmologists.

How far the states will carry out these recommendations, we do not know. They have been issued only about a month, and the states are just beginning to establish the physical restoration programs. We are hoping, though, very much, that in all communities where there are ophthalmologists available at hand or nearby, the state agencies will send every applicant who has a visual handicap, for examination by an ophthalmologist.

Of course, where there are distances to be covered, it is probable that the states will have to rely, and will rely, on the general medical man's opinion as to whether this particular visual handicap requires an ophthalmologist's examination or not. We know there will be errors in that. As far as we can see, though, the only practicable thing is to rely on the general medical man because that is the only possibility not requiring two or three hundred miles of travel which might be necessary to reach an ophthalmologist in some states.

In establishing their physical restoration services, the Federa Office requires that each state agency have a medical consultant, who will be part- or full-time, and available for daily consultation. He may be an ophthalmologist or may not be, depending on what the state may choose—and in addition a professional advisory committee on which ophthalmology will be represented.

The national office has established a professional advisory com-

mittee, and the ophthalmologist selected for that committee, partly upon the recommendation of the National Society for the Prevention of Blindness, is Dr. Purman Dorman of Seattle, Washington. Many of you have heard of him. He is very active in aid to the blind, and other services for the blind, in the State of Washington.

In providing services, after the examination, for the handicapped client, the state agency will be guided by the opinion of the examining physician or physicians, including that of any specialists who examined the case.

If the individual has a handicap which is an employment handicap and which is static and remediable, and if the individual is in financial need, then the state agency may furnish him or her with the necessary medical services to correct that disability without cost. Such services may include anything from a single doctor's visit to hospitalization and surgery. Hospitalization, however, is limited to ninety days in any one case, so far as federal reimbursement is concerned.

Once the physical restoration is accomplished, the individual will then in many cases receive vocational training suitable for his particular disability, and eventually be placed in a suitable job. That is the aim of the program; and the philosophy of our office and of the state agencies, is that an individual is not fully rehabilitated until he is placed in employment in a capacity in which he is able as a worker to compete on normal terms with other workers; in other words, though he is a handicapped individual, he is not handicapped for that particular job and should be able to compete satisfactorily with normal individuals. That is true not only for all other types of handicapped persons, but also for the blind, for whom we have a special section. It should be noted, however, that the state rehabilitation agencies place disabled individuals, not only in ordinary industry and agriculture, but also, when necessary, in sheltered workshops and in remunerative work in their homes.

The place of the blind person in industry has been greatly enlarged of recent years. The head of our section for the blind is Mr. Joseph Clunk, himself totally blind, and a great worker for placement of the blind in industry. All these handicapped in-

dividuals will, of course, receive full physical examinations in addition to examination of the eyes, because, after all, if a man has an arm off, and goes to a job suitable for a person with one arm, he may fail at this job because he has bad vision too. That would obviously not be successful rehabilitation.

We know of individuals placed satisfactorily, with one leg off, who six weeks later died of tuberculosis because nobody did an examination of their chests. We now hope to avoid such serious errors.

In passing, I should like to mention the training course for blind placement agents, which began last Monday in Baltimore. This, so far as we know, is the first course of its kind in the world. There are assembled in Baltimore about twelve totally blind individuals from different states who are to spend six weeks there under the auspices of the national office, learning jobs by going into some twenty-one industries in Baltimore and actually learning how to operate different machines and different processes. These individuals, having been trained in these twenty-one industries, in about one-hundred-and-twenty-five different kinds of jobs, and being able to do them themselves, will then return to their state agencies as placement agents for the blind. They will demonstrate to the employers in their own states the capacity of a blind individual to do a given industrial job and, having demonstrated it, the placement agent will then be able to place a blind individual in a job which up to that time an employer did not realize a blind person could do.

It seems to me that we have a tremendous opportunity ahead of us in the rehabilitation program to co-operate with the National Society for the Prevention of Blindness, and the Industrial Hygiene Division of the Public Health Service, in placing visually handicapped individuals according to some better standards of visual requirements of jobs than we have ever had before.

We know that in the past the vocational placement agencies have had to place handicapped individuals more or less by guess, and it will be a tremendous asset to the program which we are very eager to take advantage of, to have the information that Dr. Lo-Presti, the National Society for the Prevention of Blindness, U. S. Public Health Service, and others have been gathering in in-

dustries. We are hoping it will be made available to the rehabilitation agencies for their use in placing visually handicapped individuals in suitable opportunities. In our turn we will be able, we hope, to collect data of interest and use to the National Society and other groups interested in the prevention of blindness and in work with the blind. As time goes on we will learn more about the success of visually handicapped persons in different types of jobs, not only from an industrial standpoint but from a medical standpoint. We will follow up placements of these individuals, so that we can know not only about their success from an industrial standpoint but also the effect on their health, of the jobs they do.

Finally, although this is primarily a civilian program, it is a fine opportunity for preparation of our schools and our industries for the rehabilitation of our veterans. We are now starting with this backlog of three or four million handicapped people in the United States, and through our experience in physical restoration, vocational training, and placement of these individuals, we hope that not only the vocational rehabilitation agencies, but also the industries themselves, will learn, in the next year or so, about the satisfactory employability of handicapped individuals. When our veterans begin to come back in large numbers, we will then have helped to lay the groundwork for the satisfactory rehabilitation and re-employment of our service-disabled veterans.

The Forum

THIS section is reserved for brief or informal papers, discussions, questions and answers, and occasional pertinent quotations from other publications. We offer to publish letters or excerpts of general interest, assuming no responsibility for the opinions expressed therein. Individual questions are turned over to consultants in the particular field. Every communication must contain the writer's name and address, but these are omitted on request.

Children With Visual Limitations

Parents of a visually handicapped child must have numerous questions in regard to rearing him. What kind of person will he become? What kind of life will he have? Will he be a happy person? This message is for those parents whose children are not blind but have a visual handicap serious enough for placement in a sight-saving class.

At the outset, it is of course essential that everything possible be done to overcome whatever difficulty exists, but if it cannot be remedied the child's parents must consider what kind of person he is to become. It is in the earliest years of a child's life that the basic patterns of his life are laid. The kind of person he will become will depend in large measure on how well his parents learn to understand him and to treat him as an individual. He has his own pattern of growth, and the parents' responsibility is to create the most favorable conditions for that growth. Parents sometimes ask why they should spend so much time with the child during the first year of life. Can't a nurse look after his physical needs during infancy just as well as they? One answer to this question is that what the parents learn about the child when he is very young will be of great value throughout his childhood and adolescence because he is likely to display the same dynamic characteristics then as earlier. Then, too, there is the child's need to feel loved and wanted. A limitation such as low vision may very likely make a child feel physically and emotionally insecure. For this reason, it is especially important to make him feel wanted and needed. Emotional security will help make up for his feeling of physical insecurity.

If the parents of the visually handicapped child know about the child's visual limitation early in his life, it gives them time to become accustomed to the idea. This is valuable because it is one thing to know about his limitation, and another to face it and learn how to live with it. This last is very important because the parents' attitude and feeling about it will be quickly felt and understood by the child. It will also be reflected by members of the immediate family, other relatives, and friends. If the attitude is one of over-protection, it may result in his exclusion by the children in the neighborhood from their activities, because they don't want to be bothered with someone who is different or who might require extra attention from them. Something might happen to him!

We should like to tell you about the little boy whose eyes appeared different from those of other children. His mother had him join the local YMCA so that he could take advantage of the swimming pool during hot summer days. The boys who were strangers to him asked him what was the matter with his eyes. At first he hesitated to tell them, but finally, when they persisted, he told them exactly what was wrong with his eyes. Their curiosity was satisfied once they knew the facts, and they now accept him as one of the group. A wholesome attitude on the part of both parents and child, as well as understanding by playmates, is most important, and must be developed early in the child's life if he is to be a happy adult.

As parents better understand the needs of the child's growing personality, the more wisely will they be able to play their part. It is natural that parents of a physically handicapped child should feel powerful impulses to make up to him for his deficiency; but yielding to these impulses may have effects opposite from those which they desire. Their impulse to make good his deficiencies is an impulse to ease a pain. It is hard to accept a deficiency in one we love; but it is the part of wisdom and understanding to accept limited vision in a child and to gain his acceptance of it. A child with limited vision is not aware of much he does not see, and will not be uncomfortably aware unless his parents and others make him so. Parents should be perceptive and sensitive to such a child's behavior at all times, but their sympathy should be guided by an objective awareness of his need for courage and initiative in doing things for himself. By such an attitude, consistently maintained, they may best ease their own pain and help the child to compensate in wholesome ways for his limited vision.

Instead of deriving satisfaction by "doing" for him, parents must discipline themselves to teach him to do it for himself. This takes time and limitless patience, but the child

will derive exhilaration and satisfaction from his accomplishment. It isn't the size of the task which counts, but it is the fact that through "doing" it himself he becomes self-reliant. With the feeling of physical independence will come a sense of responsibility, and ultimately of freedom. A mother tells us that since the war she has lost her maid, and through necessity her ten-year-old daughter, who has low vision, has had to help with the housework. She not only does it well, but enjoys it. She would like to caution parents not to spoil their children who have physical limitations! It is important, then, for the child to acquire early in life a feeling of success, both in work and in play.

Little has been said about general health. We want to stress that there is a direct connection between it and stability of character. General health should be maintained at the highest level, and particular attention should be given to the eyes. If glasses are necessary, they should be kept clean and properly adjusted. Eyestrain should be avoided.

A noted physician tells us that vision is so fundamental in the growth of the mind that the baby takes hold of the physical world with his eyes long before he takes hold of it with his hands. Yet he cannot achieve full acquaintance with things through the eyes alone. He must feel them with his hands. The world of the child with low vision is necessarily more limited than that of the child with normal vision. Parents can help make his life richer through proper attention to his environment. As an infant he should have simple toys around him, such as rattles, small bells, soft balls, soft stuffed dolls; music, too, should play a part in his world. Colored toys will help him recognize and find them. Gradually, the child will learn to amuse himself without the constant attention of his parents. Yet, he must learn to play with other children, and to be accepted by them. Through play activity which is creative, the child develops self-confidence. By participating in the group he learns to be social and derives the benefits of getting along with others. Nursery school should be an excellent experience for the child with low vision, because it gives special training under supervision. This is valuable, for there is a tendency for these children to be less active, less aggressive, and to have less initiative. Parents of a child with low vision need not be surprised if he is somewhat retarded in his speech habits, since his ability to imitate decreases in proportion with the decrease in vision. Of course, steps should be taken to correct any speech defects as soon as possible, for obvious reasons. Association with other children would be of value in this respect.

May we sum up by reminding parents to try to see the child in

terms of what he is, and what he has. Mrs. Hathaway, Associate Director of the National Society for the Prevention of Blindness, says: "The first step in all modern education is to find wherein strength lies and to build upon that as a foundation." Don't live only for the child, live with him. Have other interests and activities so that his life will be richer through living with someone who has an actively interested mind. The child cannot help having bumps, as all children must; and parents cannot prevent them, but they can help him be strong enough and flexible enough to take them as they come with poise and equanimity.

—MARGARET RARIG OSTERMAN
Washington, D. C.

Note and Comment

National Society Honors Its President.—In recognition of his devoted service as head of the organized movement for protection of eyesight and the conservation of vision, Mason H. Bigelow, President of the National Society for the Prevention of Blindness, was presented with an illuminated scroll by the Board of Directors of the Society on the occasion of its 30th Annual Meeting in New York City.

"Too often we take for granted this kind of service and leadership and miss the opportunity of voicing our sentiments when they are so richly deserved," commented Dr. John L. Rice, former Health Commissioner of New York City, and member of the Society's Board, in making the presentation.

"There are many modest men, giving freely splendid service to their fellow men, who fail to receive the recognition which is their due. The National Society for the Prevention of Blindness has one of these outstanding, splendid modest men as its President, and today it is my happy privilege to present to him in the name of the Board of Directors their thanks in the form of an inscribed document which reads as follows:

" 'The Directors of the National Society for the Prevention of Blindness, Inc., take occasion to record their high appreciation of the competent, devoted service that is being rendered by President Mason H. Bigelow to the Society and to the cause of eyesight conservation. At sacrifice of time and convenience, he is contributing leadership of an effectiveness that is gratifying and inspiring to the Directors. This leadership exemplifies and personifies the spirit of philanthropy which so largely characterizes the object and work of this Society.' "

Ophthalmic Gold Medal.—From the *Journal* of the A.M.A., we learn that The Ophthalmological Society of Egypt will award a gold medal annually for the contribution deemed most valuable that year in the field of ophthalmology. A competitive essay will determine the award, which will be considered at the annual

congress of the Society. Additional information may be obtained from the Ophthalmological Society of Egypt, Dar el Hekma, 42 Kasr el Ainy Street, Cairo.

Dr. Alan C. Woods, Baltimore, was named president-elect of the American Academy of Ophthalmology and Otolaryngology at its annual meeting in Chicago, October 12, and Dr. Gordon B. New, Rochester, Minn., was inducted into the presidency. New vice presidents include Drs. Edmund B. Spaeth, Philadelphia, William H. Johnston, Santa Barbara, Calif., and Lieut. Col. Brittain F. Payne, M.C. The next annual meeting is scheduled at the Palmer House, Chicago, October 7–11, 1945.

Collection of Historic Tonometers.—The tonometer checking station at the Illinois Eye and Ear Infirmary is making a collection of historic tonometers. Will any reader who has a tonometer of interest for this collection donate it for display? Credit will be shown. Any descriptive letters of such tonometer will be appreciated. Address Dr. Harry S. Gradle, 58 East Washington Street, Chicago.

Institutes Co-operative Project with War Production Board.—In a letter to American industrial managers, Donald M. Nelson, then Chairman of the War Production Board, asked their co-operation in a drive to improve production through the conservation and utilization of eyesight in industry.

"This is a matter of great practical importance to the war effort, as well as to postwar production," Mr. Nelson said.

Mr. Nelson said that the U. S. Public Health Service, Department of Labor, War Manpower Commission, and WPB, with the co-operation of the National Society for the Prevention of Blindness, are offering assistance to industrial plants for the improvement of "visual-production" conditions.

He said that studies made in many industries show that management can realize production gains of as high as 25 per cent by constructively attacking this problem through the use of corrective glasses, proper lighting, protective eye equipment and job reassignment.

The WPB chairman explained that disturbing key facts brought

to light by investigations of the National Society for the Prevention of Blindness were:

Subnormal eyesight keeps 25 per cent to 40 per cent of war workers below normal production.

Inadequate illumination and glare in many factories handicap the entire working force.

Absenteeism, fatigue and accident rates are substantially increased by eye strain.

Protective goggles and other equipment are often not supplied in sufficient numbers, not properly fitted, and not adequately maintained and used.

Mr. Nelson said that the service to industrial plants for the improvement of visual conditions now adversely affecting production is offered without charge by the combined government agencies co-operating with the National Society for the Prevention of Blindness.

Mr. Nelson's letter closes with the comment: "When a job needs vision, a man cannot work better than he can see."

In the carrying on of the co-operation with these governmental agencies, Mr. Charles P. Tolman, the Society's consulting engineer, will act as liaison officer. As of November 15, Miss Florence Nelson, formerly editor of *Safety Education*, has been engaged by WPB to assist in the carrying on of this program in the Society's offices.

Inter-American Health Service in Paraguay.—A report has been published covering the first two years of the Inter-American Cooperative Health Service in Paraguay. Appearing in the *Newsletter* of the Health and Sanitation Division of the Office of the Coordinator of Inter-American Affairs, the report covers the two-year period from 1942 to 1944. One of the first undertakings of the co-operative health service in Paraguay was the construction of a large building in Asunción to provide office space for the ministry of health, the director of the department of public welfare and the director of the department of hygiene, as well as space for a number of the divisions of the department of hygiene and the principal health center for Asunción. Among the clinics provided in the health center section is one for eye, ear, nose and throat.

Orthoptic Clinic Established in Indianapolis.—An orthoptic clinic has been created at the James Whitcomb Riley Hospital for Children, Indianapolis, to provide special training for children having difficulty in eye focusing and to supplement surgery for correction of crossed eyes. The new unit will add to the Indiana University Medical Center's facilities, of which the Riley Hospital is a part.

New Periodical on Reconditioning.—A new publication, *Reconditioning News Letter*, is now being distributed monthly by the Office of the Surgeon General to all Army Service Force hospital commanders and service command surgeons. Its aim is to familiarize hospital personnel with new ideas, practices and procedures connected with the reconditioning program. Sources of the items published are reports made by inspecting officers from the Surgeon General's Office, chiefs of the reconditioning branches in service commands, medical officers and others familiar with the program.

Dr. Raphael Silva.—Mexico lost one of her leading ophthalmologists, Dr. Ralphael Silva, April 16, 1944. Having studied in Europe under Professors Fuchs and Axenfeld, he opened practice in the office of Dr. Fernando Lopez. From this beginning he became ultimately director of the Ophthalmic Hospital of Nuestra Señora de la Luz. Among other appointments, Dr. Silva has held those of professor of ophthalmology at the Escuela de Altos Estudios; director of the Health Department of Mexico; member of the committee awarding the Kellogg Foundation-Pan-American Congress of Ophthalmology fellowships.

Institute on Nursing Care of Eyes in Industry.—At the request of a group of industrial nursing consultants and supervisors, and in conjunction with the annual meeting of the American Public Health Association, a conference on eye health in industry was conducted in New York City, early in October. This was a milestone in the Society's industrial nursing program, being the first institute-type of conference on nursing care of eyes in industry. Forty-seven consultants, supervisors, and instructors, from 16 states and two Canadian provinces attended the three sessions.

Speakers included Dr. Joseph Lo-Presti, Assistant Surgeon (R), U. S. Public Health Service, assigned to the Society, Mr. Frank J. Connell, safety engineer of the Sperry Gyroscope Company, and Miss Eleanor W. Mumford, R.N., the Society's associate for nursing activities.

Society's Glaucoma Exhibit Gets Award.—At the last meeting of the American Academy of Ophthalmology and Otolaryngology, the "First Award for Excellence in Presentation in Ophthalmology" was given to the glaucoma exhibit organized by Dr. Mark J. Schoenberg, chairman of the Committee on Glaucoma of the National Society for the Prevention of Blindness, with the cooperation of the Committee and other ophthalmologists. Miss Virginia M. Smith, staff associate, who assisted in the preparation of the exhibit, was available for consultation at the booth during the Academy Meeting, which took place in Chicago, October 8–12.

Upon invitation, Mrs. Eleanor Brown Merrill, executive director, and Miss Isobel Janowich, editor, presented the exhibit on progress in sight conservation, at the Academy Meeting. The exhibit, which emphasized mainly industrial ophthalmology, also included a small section on glaucoma, in which the Minnesota Society for Prevention of Blindness co-operated. Dr. Joseph Lo-Presti presented a paper on "The Connecticut Experience with Eye Problems in Small Industries," at the meeting sponsored by the Joint Committee on Industrial Ophthalmology. Dr. Lo-Presti, Mr. Tolman, and co-operating ophthalmologists, were available for consultation, especially in the field of industrial problems.

Society of Kellogg Fellows.—The organization of the Society of Kellogg Fellows was recently announced. Named in honor of the founder of the Kellogg Foundation, the society aims to stimulate professional and educational activities of Latin-American ophthalmologists. Dr. Harry S. Gradle, Chicago, was chosen honorary president. Members of the Society are all Latin-American ophthalmologists who have carried on postgraduate studies in their speciality through the aid of the W. K. Kellogg Foundation and the Pan-American Congress of Ophthalmology. Members of the organizing committee are Drs. Daniel Silva, Mexico; Agustin Perret, Venezuela; and Manoel A. da Silva, Brazil. The final

steps to complete the organization were taken during the annual meeting of the A.A.O.O. in Chicago, October 8–12. *Ophthalmologia Ibero-Americana* has been designated the official journal of the Society.

Medical Social Consultant in Vocational Rehabilitation.—Marian E. Russell, executive secretary of the American Association of Medical Social Workers, has been appointed medical social consultant in the office of vocational rehabilitation, Federal Security Agency. Miss Russell will aid in the formulation and development of medical social aspects of the vocational rehabilitation program, especially as they relate to physical restoration of disabled persons. She will provide consultant and technical services for the federal office and for the state divisions of vocational rehabilitation and the state agencies for the blind.

Fifth Anniversary of Sociedad de Oftalmologia del Litoral.—The *Sociedad de Oftalmologia del Litoral*, Argentina celebrated the fifth anniversary of its founding, during its regular scientific session. Dr. Carlos Weskamp, President, summarized the accomplishments of the Society during the last year.

A National Health Service in Britain.—The British government has announced its intention to establish a National Health Service for all Britons, and has invited frank criticism of the proposal. Like the Wagner-Murray-Dingell Bill in this country, it has engendered considerable controversy. Under the existing National Health Insurance, British ophthalmologists operate as consultants. Ophthalmologists feel that refracting opticians should be co-ordinated, though subordinately, with ophthalmologists. Opticians, on the other hand, as in this country, argue that refraction is the peculiar domain of the optician and that medical training does not prepare others to perform it; that ophthalmologists and opticians should regard themselves as complementary to each other.

Eye Examination in School Children.—Dr. Lawrence T. Post, in an editorial of the *American Journal of Ophthalmology* (September, 1944) reflects that one of the most important contributions to eye welfare has been the establishment of ocular examinations in

schools. The nature of the tests is of course important. Of factors pertaining to sight: external diseases, central visual acuity, muscle balance and power, fields of vision, fundoscopy, color discrimination, fusion and refraction—at least the first two, and perhaps the third, should be tested in schools. With respect to visual acuity, Dr. Post advises that in addition to the 20-foot test, tests at reading distance should be given. Complete tests should be made in the schools and in the offices of ophthalmologists to whom children with reading difficulties are referred, and the direction of remedial reading by a trained psychiatrist will succeed in certain cases.

New Glaucoma Prize.—A prize of $500 for the most valuable original paper adding to existing knowledge about the diagnosis of early glaucoma or the medical treatment of non-congestive glaucoma is being offered by the National Society for the Prevention of Blindness. This award will take the place of two separate prizes of $250 each which had been announced some time ago.

Papers may be presented by any practicing ophthalmologist of the Western Hemisphere and may be written in English, French, German, Italian, Spanish or Portuguese. Those written in any of the last four languages should be accompanied by a summary in English.

The award will be made by the Society with the guidance of an ophthalmological committee composed of Doctors John N. Evans, Frank C. Keil, Daniel B. Kirby, Arnold Knapp, John M. McLean, R. Townley Paton, Algernon B. Reese, Bernard Samuels, Kaufman Schlivek, Mark J. Schoenberg, Manuel Uribe Troncoso, David H. Webster.

Latin-American Developments.—The Mexican Association for Prevention of Blindness celebrated its twenty-fifth anniversary in August with an eight-day conference in Mexico City. Delegates from various countries participated, and the Society extended greetings through a representative who was in Mexico at the time. It will be recalled that Dr. Luis Sanchez Bulnes, a guiding spirit of the Association, represented his country at the Society's Annual Meeting last year.

Two medical social workers from São Paulo, Brazil, Miss Maria

Conceicao de Carvalho and Miss Andreina Campanella, are attending the course in medical social eye work sponsored by the Society at Washington University, St. Louis, during the present semester. Training for these workers, who will return to Brazil to undertake responsibilities requiring this special preparation, was made possible through assistance from the Office of the Co-ordinator of Inter-American Affairs.

Physicians Warned to Exercise Care in use of "Doryl" for the Eyes.—A warning to physicians to exercise care in the use of "Doryl," a crystalline preparation intended only for use in the treatment of eye diseases, is made by *The Journal of the American Medical Association* in its December 18 issue. Deaths have recently been reported following injection of the preparation, *The Journal* says, explaining that the drug "is available as a solution in ampules for intramuscular injection and as crystals for use in preparing solutions for the eye. Because the crystals also have been marketed in ampules, errors have been made in preparing these crystals for injection rather than using the available ampule solution for intramuscular use. The deaths which followed injection were due to the fact that the concentration was several hundred times greater than it should have been. . . ." Despite changes in labeling and packaging, at least two deaths have since occurred. The firm has now asked for the return of all Doryl shipped prior to October 1, 1943. "Physicians," *The Journal* warns, "should examine carefully their own supplies to prevent further accident."

Henry Randolph Latimer.—Readers of the REVIEW will be grieved to hear of the death of Mr. Henry Randolph Latimer, for many years the executive director of the Pennsylvania Association for the Blind. Mr. Latimer was not only a leader in the field of the care of the blind, but in the field of prevention of blindness.

Book Reviews

YOUR EYES. Sidney A. Fox, M.D. New York: Alfred A. Knopf, 1944. 191 p.

The author has undertaken the difficult rôle of teaching his readers what they should know about their eyes. As he rightly states in his preface, what the average man knows is often misinformation gleaned from sources more interested in selling a product than in disseminating accurate facts.

The chapters cover a wide variety of subjects which include eyeglasses, color vision, tinted glasses, the eye muscles, illumination, the eye in traffic, eye physicians and optometrists, quacks and panaceas, hygiene and first aid, the young, adult and old eye. The index is complete and informative.

Ordinarily a layman would not be expected to comprehend so much material in the realm of science. Major Fox, who was a practising ophthalmologist in New York City, is gifted with an entertaining literary style that lifts up the reader's interest just as a topic begins to "get dry." One wonders whether the average person is sufficiently interested in blepharitis, vernal catarrh, trachoma and the technicalities of color vision to have them treated in a popular treatise. Far outweighing this criticism is the theme throughout that "ailing eyes should receive prompt and competent attention."

Dr. Fox's approach is similar to the educational campaign of the National Society for the Prevention of Blindness and he has reprinted in full their 12 rules for the glaucoma patient. He rightly pleads for the routine eye examination of all children at the ages of 3, 7 and 12, when most can be accomplished in the field of prevention.

The functions of the eye physician and optometrist are intelligently presented and quackery, particularly as exemplified by the "sight without glasses" faddists, is completely exposed. Vitamins are also subdued and put in their proper place.

Every eye physician is familiar with the many questions asked daily by patients, that are so well answered by the author. The food

for thought in this book is not new but it has been made more palatable and is easier to digest. *Your Eyes* deserves a wide circulation among the laity, social workers, and general practitioners of medicine.

—JAMES W. SMITH, M.D.

INDUSTRIAL OPHTHALMOLOGY. Hedwig S. Kuhn, M.D. St. Louis: The C. V. Mosby Co., 1944. 285 p.

Dr. Kuhn has written a comprehensive and concise treatise relating to the various problems in industry which bear a special relationship to ophthalmology.

The research and investigative work upon which this volume is based was undertaken by a Joint Committee on Industrial Ophthalmology representing the Section on Ophthalmology of the American Medical Association and the American Academy of Ophthalmology and Otolaryngology. To this work, the author has made many contributions. Her experience in the many phases of the problems of vision in industry, has been an extensive one.

The book presents, in a very systematic manner, a broad eye program for industry. It includes, in its six chapters, a consideration of vision testing in industry; correction of visual defects for the job; and the important relationship to industry of "visual skills." The chapter on "Eye Protection" is devoted primarily to a discussion of the various factors which enter into a proper goggles program.

A chapter is devoted to recent developments as related to industrial eye problems. Included are a consideration of the all-important matter of proper illumination, medico-legal angles in the handling of eye cases, problems of radiation, welding and "flashes," and problems of visual rehabilitation.

Dr. Albert C. Snell has contributed an authoritative chapter on the medical and surgical treatment of eye injuries.

The appendix contains suggestions for the basic treatment of toxic hazards, a glossary of toxic substances and their effect, an all-inclusive outline of an eye program for industry, and a section relating to the "appraisal of loss of visual efficiency"—a standard method approved by the Section on Ophthalmology of the American Medical Association.

The subject matter of this book is covered in 285 pages. There are 114 text illustrations, including 2 color plates. The book is interestingly written, it is authoritative, and practical. It should be "first reading" for all who are interested in ophthalmology in industry.

—GEORGE FREIMAN, M.D.

BLOOD TRANSFUSION IN OPHTHALMOLOGY. Eye Clinic of the Tashkent Medical Institute. Tashkent, U.S.S.R.: State Publishers, 1941. 56 p.

This book contains nine articles by ophthalmologists of the Eye Clinic of the Tashkent Medical Institute on the value of blood transfusions in ophthalmology. Prof. P. F. Arkhangelsky and his associates have been using blood transfusions since 1935. They used mostly conserved blood (from one to sixteen days), in small quantities (from 75 c.c. to 250 c.c.), with an interval of about 10 days and regarded the action of the blood as non-specific, possibly accelerating the metabolism of the tissues and activating the reticule-endothelial system.

Blood transfusions were applied in various eye diseases, but the most striking results were obtained in vitreous opacities regardless of the etiology; next were hemorrhages in the retina, soft lens matter in the anterior chamber after extra-capsular extraction. Favorable results were also observed in trachomatous pannus and herpetic keratitis by using subconjunctival injections of blood (from 0.5 c.c. to 1.5 c.c.). One of the writers (Meschersky) reported that two patients with chronic glaucoma responded well to blood transfusions as the tension was lowered, the visual acuity and visual fields were increased. A few cases of blepharitis, which did not respond to any type of therapy, improved considerably under blood transfusion therapy. Some cases of corneal transplants which became opaque cleared up after the blood transfusions. These latter, however, are not considered to be a panacea for all ills, and the writers state that blood transfusion should be applied only when all other measures fail. It could also be applied as a prophylactic measure before intra-ocular operations. A plea is made for further study of the therapeutic action of the blood in pathological conditions of the eye.

—OLGA SITCHEVSKA, M.D.

Briefer Comment

A MANUAL FOR PARENTS OF PRE-SCHOOL BLIND CHILDREN. Edith L. Speer, Director, The Lighthouse Nursery School. New York: New York Association for the Blind, 1944. 20 p.

Miss Speer elucidates the aspects of development of the blind child which differ from those of the sighted—the "blindisms" into which he so easily falls—but emphasizes that in every respect the child should receive training as nearly as possible approximating that of the normal, to prepare him for living independently among the seeing.

The pamphlet illumines methods and procedures of training from birth to school, and will interest not only parents, but teachers and others as well.

MANUAL OF INDUSTRIAL HYGIENE AND MEDICAL SERVICE IN WAR INDUSTRIES. William S. Gafafer, D.Sc., Ed., prepared by the Division of Industrial Hygiene, National Institute of Health, U.S.P.H.S. Philadelphia: W. B. Saunders, 1943. 466 p.

This handbook was prepared as a source-book for experienced industrial physicians meeting new conditions in war-converted industries, and for those physicians new in the field, who are taking the places of those in service. It consists of three parts: "Organization and Operation of Facilities"; "Prevention and Control of Disease in Industry"; and "The Manpower Problem." Those concerned with industrial vision will find chapters 2, 4, 16, 20 and 22 of particular interest.

THE PRINCIPLES AND PRACTICE OF INDUSTRIAL MEDICINE. Fred J. Wampler, M.D., Ed. Baltimore: The Williams and Wilkins Co., 1943. 555 p.

Like the U.S.P.H.S. *Manual* discussed above, this volume is intended as a guide for the physician entering the industrial field; but it is designed also as a textbook for developing the curriculum in industrial medicine. Dealing relatively briefly with methodology and organization of plant medical and safety departments (as compared with the *Manual*), it covers extensively the questions of environmental factors (temperature and humidity, illumination, toxic substances, electricity). Other chapters cover disease factors, accident factors (including predisposing elements and compensation), rehabilitation, and the position of women in industry. Those concerned with welfare of vision in industry will be especially interested in chapters III, X, XXVI, XXIX, XXXI.

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